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WASTE TREATMENT SECTION

Federal Water Pollution Control Administration
College, Alaska

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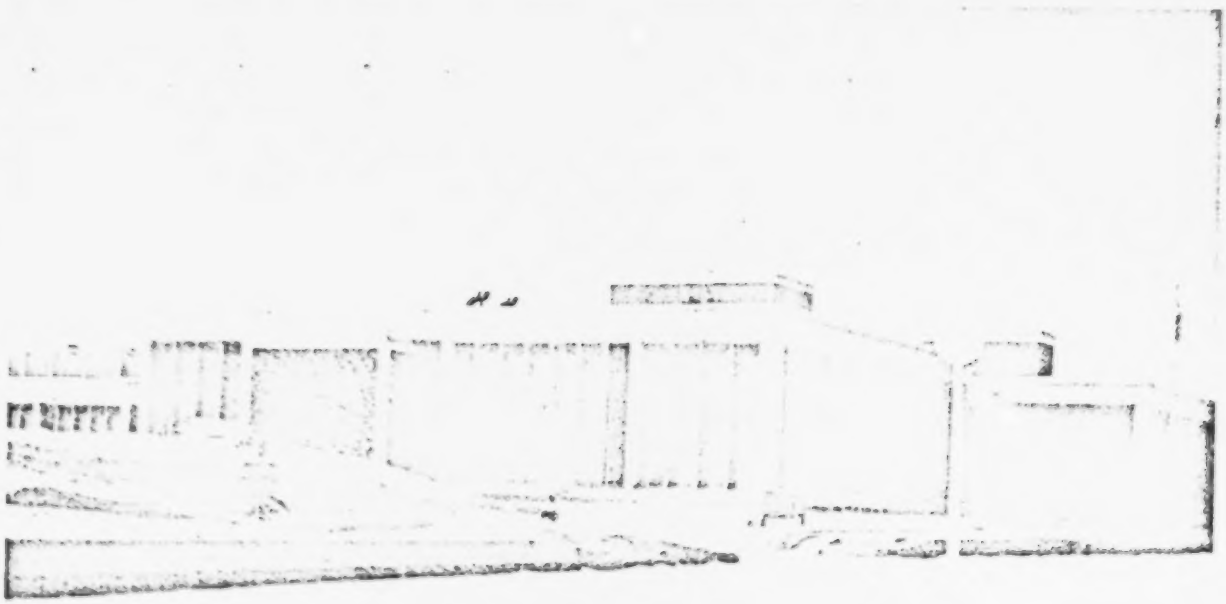
ALASKA WATER LABORATORY



QUARTERLY RESEARCH REPORT

October 1 - December 31, 1969

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ALASKA WATER LABORATORY
College, Alaska 99701

WASTE TREATMENT SECTION

PROJECT: ALASKA EXTENDED AERATION

Objectives:

Development of adequate design criteria for application of extended aeration in Alaska.

Work Completed Second Quarter FY 1970:

Modifications initiated at the Eielson extended aeration pilot facility were completed in November. Operation of the system was then resumed in mid-November shortly before a cold spell began. Primary settled domestic sewage sludge from the existing Eielson treatment plant was pumped into the basin, along with seed that had been stored while the basin was out of use, to bring the aeration basin solids concentration up to 4000 mg/l. The system was then allowed to operate with a minimum of hydraulic loading. In late December the effluent lines from the tube settlers were connected and operation at a minimum hydraulic flow rate was begun. Organic loading was maintained through enrichment of the raw sewage with primary sewage sludge.

Our observations to date demonstrate that there are several critical design considerations unique to the application of systems exposed to the environment and to the application of tube settlers.

1. Although the utilization of earthen basins appears to be

completely feasible, extreme care must be exercised in the location of tube settler modules to provide absolutely positive flow control through the hopper zone below the tubes.

2. Stabilized heavy sludge will be produced or introduced into the system and careful consideration must be given to zones where it will settle out and the "settling zones's" relationship to location of and depth under tube settler modules.
3. Tube settler modules should not be placed in a basin unless combined with a diffused air system as a complete and isolated module to guarantee that a flushing current will be maintained through the bottom hopper zone.

Our preliminary observation of the influence of surface ice brings up an important research question. We have noted a definite mixed liquor separation and suspended solids collecting effect as surface ice forms. The condition was not expected and we are not positive that it will result in a healthy activated sludge biomass or that it will continue to happen after a major ice layer has formed.

Our constant temperature studies are showing that a stable system can be operated at 1°C and a high level of BOD and solids removal maintained. Operation at 6.5 to 7°C creates a biological system that is much more susceptible to upset. Temperature changes and operation in the 2 to 7°C temperature range seem to have more adverse effects than operating consistently at 0.5 to 2°C.

Third Quarter FY 1970 Work Plan:

1. Complete hydraulic tests for determination of required tube settler modifications.

2. Conduct laboratory tests to define the settling characteristics of tube settlers of various sizes.

3. Conduct laboratory tests to determine the influences of temperature changes on a 12-hour detention time extended aeration system for the temperature range of 0.5°C to 8°C.

4. When the weather permits, complete necessary modifications to the tube settler modules at the Eielson pilot facility and re-establish a process.

5. Monitor operating efficiencies of the Eielson pilot facility.

PROJECT: COLD REGIONS AERATED LAGOON

Objectives:

To establish design criteria for the aerated lagoon waste treatment process in Alaska. Design criteria will include operational efficiency versus loading, evaluation of construction methods, evaluation of types of feasible equipment, and process modifications to provide more efficient plant utilization.

To evaluate parameters and contribution to effluent quality, power and maintenance costs, and reliability.

Work Completed Second Quarter FY 1970:

Modifications have been completed at the Eielson pilot facility to allow studies to determine the reduction in efficiency when the number of cells in the series is reduced and to evaluate stainless steel coarse bubble aerators as an alternate mechanical system.

Laboratory results this winter tend to confirm the results of last winter and indicate that winter start-up is completely feasible with a high level of removal efficiency to be expected within 60 days after start-up.

Third Quarter FY 1970 Work Plan:

1. Monitor the system with the coarse bubble diffusers operating.
2. Provide intermixing in cells 1, 2, 3 and 4 in combinations

that will allow us to develop relationships between numbers of cells, relative length of detention times for a given number of cells, and reduction in efficiency created by reducing the number of cells in a system.

3. Initiate the writing of a major progress report for application of aerated lagoons in Alaska.

PROJECT: ALASKA APPLICATION OF WASTE STABILIZATION LAGOON

Objectives:

To demonstrate the feasibility of waste stabilization lagoon application in Alaska, particularly utilizing winter storage and summer treatment capabilities. To develop design criteria for setting loadings, for operational schemes, etc. To investigate materials utilization and other design factors to minimize costs.

Work Completed Second Quarter FY 1970:

Modifications of the Eielson pilot facility lagoon have been completed and the system was placed in operation in early November. The 29' x 29' lagoon is fed approximately 500 gallons per day of domestic sewage, which raises the level 5 inches per week. The feed has been overflowing the ice layer, which has built up to five feet in thickness.

Third Quarter FY 1970 Work Plan:

1. Monitoring to establish winter removal efficiency for the single cell system will be initiated.

2. A field trip to an existing lagoon at Fort Yukon will be conducted in February to determine its operating characteristics and to obtain bottom sludge for analytical analysis. The Fort Yukon lagoon has been in operation for 13 years.

WATER QUALITY SECTION

PROJECT: SIGNIFICANCE OF WINTER DISSOLVED OXYGEN IN ALASKA:

Objectives:

1. To determine the extent of the dissolved oxygen reduction in arctic and subarctic streams under winter conditions.

2. To determine the effects of the lowered dissolved oxygen levels on the aquatic organisms while under simulated arctic or subarctic conditions.

Work Accomplished Second Quarter FY 1970:

The field season was begun with dissolved oxygen data being collected on each field trip from the Chena River, Chatanika River, and Salcha River. The dissolved oxygen in the Chatanika and Salcha rivers was 9-11 parts per million and the Chena River 6-8 ppm.

Work was begun on objective #2 by gathering, modifying and erecting the living stream system in which arctic and subarctic stream conditions will be simulated. The basic tank and refrigeration unit was assembled. Modifications were made to adapt a larger cooling system to the tank. This unit is now being tested to determine the reliability, the characteristics, and the limitations of the system.

Third Quarter FY 1970 Work Plan:

Continue the field work to observe the extent of the oxygen

depression in the winter.

Continue to modify and test the living stream system until simulated arctic and subarctic conditions can be reliably maintained.

PROJECT: SAGAVANIRKTOK RIVER SYSTEM BASIN STUDY

Objectives:

To provide baseline water quality information on the Sagavanirktok River system and the immediate industrial region of the developing oil field.

Work Accomplished Second Quarter FY 1970:

The samples for the late summer conditions were taken in mid-August, and the chemical analysis and microbiological tabulation was completed by the end of December. The aquatic biology collections have been completed except for the nymph forms of some of the highly specialized groups such as Diptera. The diatoms are a specialized group requiring treatment to clean, clear and prepare permanent slide mounts for the taxonomic classification of the organisms. Permanent slides have been made of material from all of the collection sites and some of the preliminary taxonomic identification of the group has been completed. Preliminary reports of the study have been forwarded to the Regional Office for use by the various agencies working on the pipeline project.

Third Quarter FY 1970 Work Plan:

To obtain information of the changes in water chemistry and microbiology that occur in the river system during the ice covered winter period, the third and last collection of data is planned for

the last of March or the first of April.

The identification of the diatoms and the problem species of aquatic insects requires both time and a high order of technical specialization. This will be accomplished by the use of FWPCA consultants.

The Sagavanirktok River system basin study is one of the topics that have been selected for presentation at the Symposium on Water Pollution Control in Cold Climate at the University of Alaska on July 22, 23 and 24, 1970.

PROJECT: BACTERIAL QUALITY OF ALASKA WATER I. COLIFORM CONTENT OF ALASKA WATER

Objectives:

1. To obtain from all sources the accumulated coliform data for the past three years.

2. To separate the information into surface water data and groundwater data.

3. To sort the data into geographical categories, particularly with reference to streams and centers of population and compile the information in a usable form.

4. To prepare a summary and evaluation of the data and the information it presents.

Work Accomplished Second Quarter FY 1970:

The scattered laboratory data on the coliform content of Alaska water has been collected and sorted into surface and groundwater categories. This data has now been separated into geographical divisions with special reference to streams and centers of population.

The tabulated report is being prepared and will be completed by the end of the quarter.

PROJECT: BACTERIAL QUALITY OF ALASKA WATER II. DIE-OFF RATE OF ENTERIC INDICATOR BACTERIA IN A SUBARCTIC ALASKAN RIVER

Objectives:

The objectives of this study of the Tanana River from its confluence with the Chena River to its confluence with the Yukon River are as follows:

1. To determine the rate of reduction in numbers of fecal indicator bacteria.

2. To determine changes in the chemical parameters which are associated with domestic wastes.

3. To establish the time required for a water mass to travel from the mouth of the Chena River to the mouth of the Tanana River.

Work Accomplished During Second Quarter FY 1970:

Planning for the study of the winter survival of enteric indicator bacteria in the Tanana River has been completed.

Third Quarter FY 1970 Work Plan:

The study will be carried out during the last part of February and the first part of March. The acquisition of materials and equipment will be started immediately to insure their arrival before the planned starting date. Analysis and write-up of the data will begin immediately after completion of the field work and should be ready for publication during the last quarter of FY 1970.

PROJECT: THE ROLE OF MICROORGANISMS AT LOW TEMPERATURES IN ALASKAN RIVERS

Objectives:

1. Determine the rate and extent of oxygen consumption by the mixed bacterial population in a subarctic stream at 0°, 5°, 10°, 15° and 20°C, using laboratory substrates.

2. Determine the rate and extent of oxygen consumption by the mixed bacterial population in a subarctic stream at 0°, 5°, 10°, 15° and 20°C, using domestic sewage effluent which has received various degrees of treatment as the substrate.

3. Determine if there is a relationship between (2) size and composition of the bacterial population, (b) type and amount of substrate available, (c) natural environmental characteristics, and oxygen consumption at each temperature.

Work Accomplished During Second Quarter FY 1970:

Work has progressed on the selection of a complex medium for plate counts. Two temperatures were used for selection of media, 10°C for low temperature counts and 35°C for high temperature counts. M-Plate Count Broth made up at half strength from laboratory components and adjusted to pH 7.0 gave far superior results over any other medium tested at 10°C. There appears to be a difference in some aspect of nutrition between the bacteria grown at 10°C and those grown at 35°C. The medium which gave the highest count at 35°C was m-Enrichment

Broth (Difco) made up at half strength and adjusted to pH 7.0. Work is now under way to determine the optimum pH and concentration for each of the two media previously giving the highest counts.

Work is continuing on the metabolic activity of the bacteria found in a subarctic stream. Four laboratory substrates are being used to study the rate of oxygen depletion by the natural flora. Samples were obtained from an unpolluted sample station. The substrates were added in amounts to contain the same carbon content, and the samples were then placed in BOD bottles and incubated at 0°, 5°, 10°, 15° and 20°C. The dissolved oxygen content was determined at 24- or 48-hour intervals to establish the rate and extent of oxygen depletion. The initial lag phase decreased with each increase in temperature up to 15°C with the 20°C lag phase being the same as found at 15°C. The rate and extent of oxygen depletion was similar at all temperatures after the initial lag phase. A mixture of amino acids was found to give the most rapid oxygen depletion and glucose was found to give the least. In fact, there was very little depletion with glucose as the substrate.

A similar study of metabolic activity is being conducted on samples from a sample station polluted with domestic sewage effluent. Work has been completed at 5° and 10°C. Again, the amino acid mixture gave the most rapid oxygen depletion. The rate and extent was similar to that found at the unpolluted station, but the lag phase was significantly shortened. Glucose was found to give the same rate and extent of

oxygen depletion as the amino acid mixture, but had a somewhat longer lag phase. This is in contrast to the low level of oxygen depletion with glucose at the unpolluted station. Since glucose is deficient in both nitrogen and phosphorus, it is possible that one or the other or both is the limiting factor in oxygen depletion using glucose as the substrate.

Third Quarter FY 1970 Work Plan:

Work will continue on the selection of complex media for plate counts. The optimum pH and concentration will be determined for high and low temperature counts from an unpolluted station. As time permits, a similar examination of the media will be conducted on samples from a polluted sample station.

Work will continue on the metabolic activity of the natural flora in a subarctic stream. Laboratory substrates will be studied for their effect on oxygen depletion in samples from a polluted sample station at 0°, 15°, and 20°C. A more carefully controlled study will be done to compare the rate and extent of oxygen depletion at all temperatures using samples from both the polluted and unpolluted sample stations with the amino acid mixture as the substrate.

CONSOLIDATED LABORATORY SERVICES

Work Accomplished Second Quarter FY 1970:

To improve the efficiency of the work of chemical and biological analysis, a consolidated laboratory service was established at the Alaska Water Laboratory. The following items summarize the work accomplished during the quarter.

1. Analysis for chemistry and aquatic biology of the North Slope, South Slope, and pipeline studies was completed and data cards punched for storage in STORET. The first STORET printout for edit purposes has not yet been received.

2. Laboratory space utilization has been altered to increase effectiveness and to eliminate duplication of areas so that other branches may have more space available for their use.

3. Work continues on demand analysis, physical analysis, and nutrient analysis of samples from the waste treatment pilot plant at Eielson and the bench scale pilot plant work at the laboratory.

4. Progress is encouraging on the data handling system for laboratory analyses and quality control standard forms for reporting of data are in common use and planning systems are being developed.

5. A series of water samples from Alaska Department of Fish and Game representing possible fish hatchery sites was analyzed. From these data, fish hatchery sites will be selected on the basis of water quality.

6. Samples from a fish kill in August in the Kenai National Moose Range on the Swanson River were analyzed for possible connection between fire retardants used on the forest fire at the time of the fish kill. There appeared to be no connection between the use of retardants and the fish kill.

Third Quarter FY 1970 Work Plan:

1. Sample analysis from the Bering River coal field.
2. North Slope water quality analysis to complete the Sagavanirktok River study.
3. Tanana River chemical analysis for winter water quality data.
4. Waste treatment pilot plant and bench scale sample analysis.

PRESENTATIONS AND PUBLICATIONS

Papers Submitted For Clearance:

Dr. Frederick Lotspeich, Effects of Large Scale Forest Fires on Water Quality in Interior Alaska.

Stephen Provant, The Effects of Pulp Mill Wastes on the Receiving Waters at Ward Cove, Alaska.

Presentations:

Sidney Clark participated in the A.S.C.E. meeting October 3-4 in Anchorage and presented a discussion on "Biological Waste Treatment in the Far North."

Sidney Clark participated in the FWPCA training course (173) in Anchorage on October 13 and presented a lecture on "Arctic Applications of Waste Treatment Processes."

Eldor Schallock participated in the FWPCA training course (173) in Anchorage on October 13 and presented a lecture on "Arctic Aquatic Environment."

Sidney Clark participated in the FWPCA seminar on Waste Treatment in Arctic Alaska November 19-20, held in Dallas, Texas, and presented "Current FWPCA Research on Arctic Waste Disposal Problems."

Alaska Water Laboratory Seminar

November 7 Dr. Patrick Kinney, Research Concerning Crude Oil in Natural Waters

November 14	Richard Latimer, FWPCA Support Grant Procedures
November 28	Robert O. Straughn, Solid Waste Disposal, Murphy Dome Project
December 19	Sidney E. Clark, Biological Waste Treatment in the Far North

STAFF TRAINING

Don Budbill attended the FWPCA course "Basic Principles of Wastewater Treatment Operations" in Anchorage October 13-17.

Harold J. Coutts attended the Pacific Northwest Pollution Control Association meeting in Seattle.

Virginia Sohn completed the first semester of the course "Organic Chemistry" at the University of Alaska.

Eldor Schallock completed the course "Oceanography 650" at the University of Alaska.

Conrad Christianson completed the course "Sanitary Engineering CE-441" at the University of Alaska.

VISITORS TO THE ALASKA WATER LABORATORY

OCTOBER

Mr. George Wirth, Research & Development, FWPCA Headquarters, Washington, D.C.

Mr. William Clothier, Research & Development, NW Regional Office, Portland

NOVEMBER

Mr. Edmund Grant, Assistant Commissioner for Administration, FWPCA Headquarters, Washington, D.C.

Mr. Douglas Shape, Administrative Officer, FWPCA Headquarters, Washington, D.C.

Mr. Russell DeGrief, Operations, FWPCA Headquarters, Washington, D.C.